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SEXUAL CHARACTERISTICS AND THE SEX RATIO IN A SELECTED LOCAL POPULATION OF THE SPECIES CETONIA AURATA (LINNAEUS, 1761) (SCARABAEOIDEA, COLEOPTERA) IN BOSNIA AND HERZEGOVINA AND NEIGHBORING REGIONS

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We analyzed basic sexual characteristics of the species *Cetonia aurata* (Linnaeus, 1761) on the basis of a sample consisting of 30♂ and 30♀ from a local population collected in the area of the village of Pediše on Romanija Mountain. After that, the numerical ratio of the aforementioned species was analyzed in 40 local populations and 2,229 individuals from Southern Bosnia, Herzegovina, Eastern Dalmatia (Croatia), Southern Serbia, and Northern Montenegro. A total number of 2,182 individuals from nine regions in Herzegovina, six in Bosnia, three in Croatia, four in Serbia, and three in Montenegro (and the total for the hypothetical metapopulation of all samples) was analyzed by the chi–square (χ^2) test. As a rule, the number of males was higher in almost all analyzed populations, but the sex ratio was lower in the Mediterranean and sub–Mediterranean areas.

KEY WORDS: *Cetonia aurata*, Bosnia and Herzegovina, Serbia, Montenegro, Croatia, sex ratio, genetics, evolution

INTRODUCTION

The genus *Cetonia* Fabricius is an almost entirely Palearctic genus which includes 18 species divided into three subgenera *Cetonia* Fabricius, 1775, *Indocetonia* Mikšić, 1965, and *Eucetonia* Schoch, 1894.

All European species, whose center is in the Mediterranean area, belong to the subgenus *Cetonia* Fabricius. The European fauna has only four (ALONSO–ZARAZAGA & KRELL, 2007) (five according to BARAUD, 2001) species, with just one of them in the central part of the Balkan Peninsula: *C. aurata* (Linnaeus 1761); the others are: *C. carthami* Gory–Percheron, 1833 (Balearic Islands, Italian Mainland, Sicily, Sardinia, Corsica, French Mainland, and Portuguese Mainland); *C. cypriaca* Alexis, 1994 (Cyprus); and *C. asiatica* Gory–Percheron, 1833 and *C. oertzeni* Reitter, 1885 (Crete; MIKŠIĆ, 1965). It has been noted that *C. asiatica* is in fact a synonym for *C. oertzeni* (MIKŠIĆ, 1982).

The species *C. aurata* is an exceptionally variable species, but mainly in qualitative sense. Individuals are medium–sized. Their body is covered by fine hair (fresh samples), with very conspicuous, often metallic shining coloration (green, coppery, purple, bronzish, and blue). The middle and posterior tibiae each have two typical movable apical spines, at the top and in the interior part. Males are clearly differentiated from females by the presence of an impression in the abdominal sterna (LELO, 2000, 2003; KAŠIĆ–LELO & LELO, 2002, 2005).

Generally, the clypeus is square, narrowed in front, impressed above the base of the antennae. The front part of the clypeus is slightly impressed. The labrum is invisible, and the upper jaws are hidden under the clypeus and are not visible from above. The antennae consist of 10 segments. The flagella of both sexes are identical and consist of three lamellae. The eyes are surrounded in front by the *lobus oculi*. The neck shield is narrower than the base of the forewings and is not bordered membranously. The scutellum is large, triangular and elongated. The forewings are more or less flattened on the surface, usually with protruding *callus humeralis* and *callus anteapicallis*, while the so–called dorsal impression is present on the posterior part of the surface along the suture. The wings are fully and well developed. The mesosternum projects forward and ends spherically. The abdomen has six free, but weakly movable sternites. Haunches of the fore–legs are withdrawn into the prosternum, while the free part is conically protuberant. Anterior tibiae have three spurs on the outer side, and the inner preapical spine is inserted in front of the base of the anterior tarsi (CURTI, 1913; MIKŠIĆ, 1982).

The subspecies *C. a. aurata* (L.) inhabits almost the whole of Europe (except for certain marginal areas), the Balkan Peninsula (except the Peloponnesus), Asia Minor, and the Euro–Siberian part of Central Asia. Two other subspecies have been found in Europe: ssp. *pisana* Heer, 1841 is found in Corsica, the French Mainland, the Greek Mainland, the Italian Mainland, Malta, Sardinia, and Switzerland, while ssp. *sicula* Aliquo, 1983 is found in Sicily (ALONSO–

ZARAZAGA & KRELL, 2007). BARAUD (2001) mentioned a fourth subspecies in Europe: ssp. *pallida* Drury, 1770 (Turkey, Bulgaria, Ukraine, Turkistan).

Adult individuals of the species *C. aurata* (Linnaeus) are exceptionally heliophilic; they feed on pollen, nectar and juice of damaged trees (MIKŠIĆ, 1965, 1982).

MATERIAL AND METHODS

Specimens of *C. aurata* (L.) were collected exclusively in dry and sunny weather during the period from 1998 to 2004 through 159 samplings carried out by various collectors at selected sites in Southern Croatia, Southern Bosnia and Herzegovina, Southern Serbia and Northern Montenegro (Tab. I, Fig. 1). The sample included 2,229 specimens from 40 sites collected by the standard method, e.g., with an entomological net or by hand (depending on circumstances), after which they were put in flasks with acetyl alcohol (CH_3COOH and C_2H_5OH in ratio 1:3). Material prepared in this way was stored in special boxes for safe transportation and much easier storage (SCHMIDT, 1970).

For laboratory analysis, the material was taken out of the flasks and investigated in detail using a microscope with magnification of 4x–8x. After that, the specimens were prepared and put on size 1 or 2 entomological pins, depending on size of the insect. They were labeled and forest out to dry for 14 days. After that period, the insects were stored in entomological boxes.

A basic sample of 30♂ and 30♀ was selected on the basis of the detailed descriptions given by MIKŠIĆ (1965). Specimens from a local population of the investigated species from the vicinity of the willage of Pediše on Mt. Romanija (July 18th, 2004, leg. M. Kašić–Lelo) were selected for the basic sample. The main criterion was the observed level of variation. The given material is stored in the private collection of Suvad Lelo, in test tubes marked as M. K.–Lelo, No. 34–40. Material stored in test tubes (10 specimens per tube) marked by the numbers, 34, 35, 36, 38, 39, and 40 was transported to the Laboratory of Invertebrate Biosystematics at the Science Faculty in Sarajevo, where dissection and morphological analysis were carried out (KAŠIĆ–LELO, 2005).

In the first comparison, the number of males in relation to females (the sex ratio) was calculated, and statistical analysis using the chi–square (χ^2) test was carried out in order to establish whether the determined ratio had statistical significance. For the purpose of statistical analysis, material was regrouped in nine samples from Bosnia, six samples from Herzegovina, three samples from Eastern Dalmatia (Croatia), four samples from Southern Serbia, and three samples from Northern Montenegro. After that, the total number of males and females was calculated for each of the above–mentioned regions and the total sample of 2,128 specimens.

Table I

Sites of sampling of the species *Cetonia aurata* (L.) (number of individuals = 2,229).

No	State	Sampling sites	Number of individuals
	BOSNIA AND HERZEGOVINA		
	Herzegovina		
1		Neum + Klek	29
2		Hutovo blato	5
3		Kravice (Ljubuški)	25
4		Blagaj	41
5		Mostar	7
6		Drežnica	22
7		Jablanica	170
8		Mt. Čvrsnica	38
9		Mt. Prenj	9
10		Konjic	107
	Bosnia		
1		Buško–Blato	4
2		Mt. Vran	18
3		Mt. Vranica	15
4		Kiseljak	2
5		Sarajevo	445
6		Pale	1
7		Mt. Romanija	212
8		Rogatica	49
9		Mt. Zvijezda	7
10		Olovo	55
11		Živinice	4
12		Maglaj	1
13		Jajce	1
14		Banovići	1
15		Kakanj	8
16		Zenica	4
17		Ustibar	4
18		Breza	5
19		Vareš	5

Table I – continued

No	State	Sampling sites	Number of individuals
	CROATIA		
	Dalmatia		
1		Živogošće	1
2		Ston	3
3		Pelješac	8
4		Makarska	42
	SERBIA		
1		Prijepolje	111
2		Sopotnica	63
3		Brodarevo	334
4		Komaran	68
	MONTENEGRO		
1		Pljevlja	72
2		Đurđevića Tara	190
3		Mt. Durmitor	33

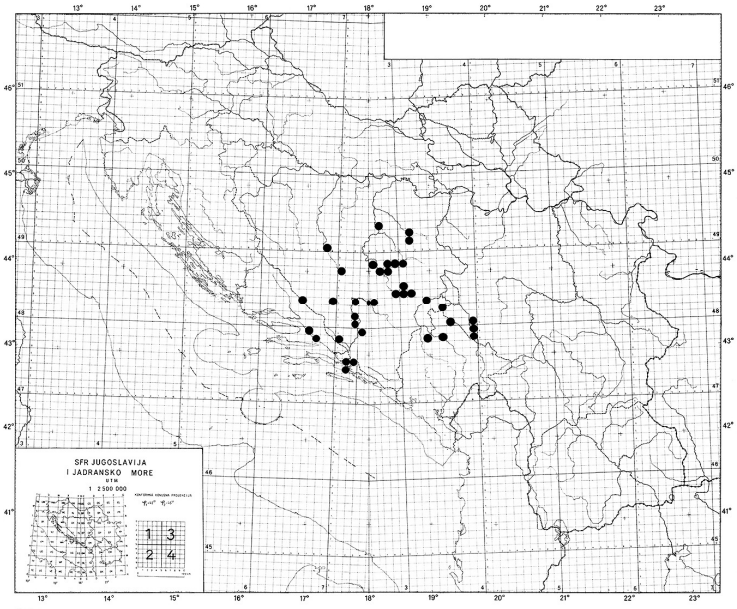

Figure 1. UTM map of SFR Yugoslavia with localities where *Cetonia aurata* (L.) was collected.

RESULTS AND DISCUSSION

Sexual dimorphism

The clear morphological distinction between sexes, in other words the evident existence of sexual dimorphism, was ascertained by analysis of 60 individuals of the examined species from a local population in the vicinity of the village of Pediše on Romanija Mountain.

Males differ clearly from females in several exomorphological characteristics.

The anterior tibiae on the outer side always have more or less clearly developed thorn–like protuberances that are more developed and more pointed in males (Fig. 2) than in females, which usually have less developed and blunt protuberances (Fig. 3).

In all examined individuals, the anterior tibiae have an inner preapical spine inserted in front of the base of the tarsus of the first pair of legs. Distally bent downwards, it is slightly longer, slenderer, and more pointed in males (Fig. 4) than in females, where it is usually shorter, thicker, and blunter (Fig. 5).

The abdomen of males toward the middle of the sternites is depressed and flattened, usually with a more or less deep impression in the first five (rarely the first three) sternites, which is generally a sufficient indicator that an individual is of the male sex (Fig. 6). In female specimens, the abdomen is rounded and without any indications of impression (Fig. 7).

Thus, by analyzing the cited exomorphological particularities of any normally developed individual, it is possible to determine its sex. In addition to this, analysis of the copulatory organ of a male showed that it consists of an outer corneous part (*forceps* or *tegumen*, Fig. 8) with a membranous penis (Fig. 9). The tegument consists of a single open basal part (*pars basalis*), which is less chitinized and made of one piece. The paired *paramerae* are elongated, symmetrical, and incompletely parallel from the base to the apex, rarely feebly expanded and then abruptly narrowed. The apical part of the *paramerae* is much narrower, with a small a tooth–like projection laterally, and the apex is finely and sharply bent outwards in a hook–shaped manner. Each *paramera* consists of a strongly chitinized black and brown inner part (Fig. 10), which forms a wide angle toward the distal end laterally, and a less chitinized part.

The female genital apparatus (Fig. 11) is a delicate saccular membranous structure. The aperture of the genital apparatus (Fig. 12) consists of two oval chitinized parts, between which (but only in some individuals) there is also a third part, more pronounced and chitinized.

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3

Figures 2 & 3. Level of development of the right anterior tibia in a male (2) and a female (3) of the species *C. aurata* (L.).

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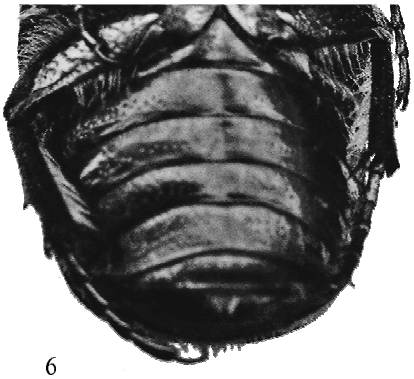
Figures 4 & 5. Level of development of the preapical spine on the left tibia in a male (4) and a female (5) of the species *C. aurata* (L.).



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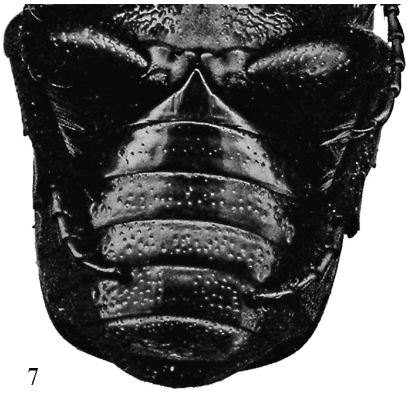

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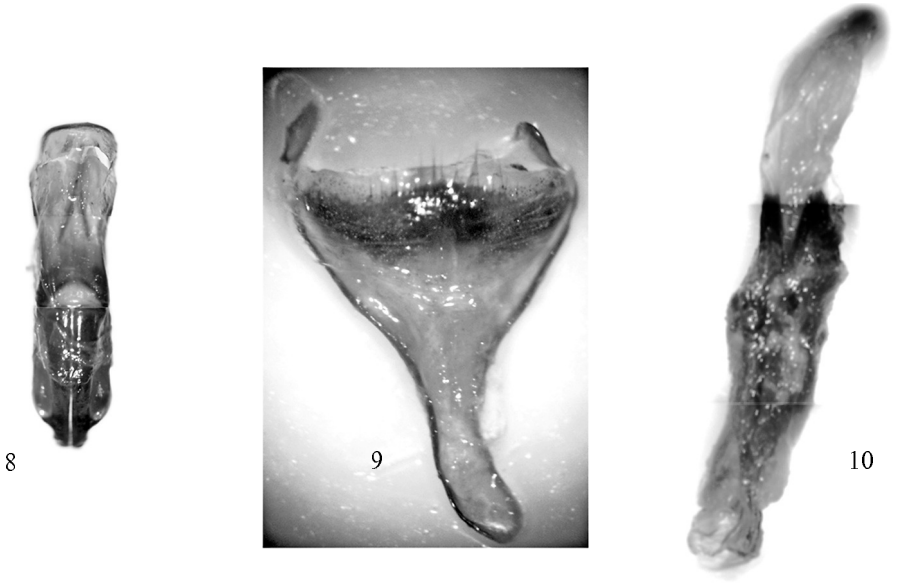
Figures 6 & 7. Form of the middle part of abdominal sternites in a male (6) and a female (7) of the species *C. aurata* (L.).

Analysis of the available literature showed that our data are compatible with other data on sexual characteristics of the sexual dimorphism of the examined species (MIKŠIĆ, 1965, 1982; BARAUD, 2001). Characteristics on the basis of which it is possible to differentiate males from females of the species *C. aurata* are discussed in the monographic reviews of MIKŠIĆ (1965, 1982). More precisely, MIKŠIĆ cites the existence of an impression on the abdomen of males (toward the middle of the

first five or fewer sternites), which does not exist in females. He also states that legs of males are somewhat slenderer and have longer tarsi, and that males have a longer pubescence on the upper side of the body. All of these data agree with the observations we made during the writing of this work.



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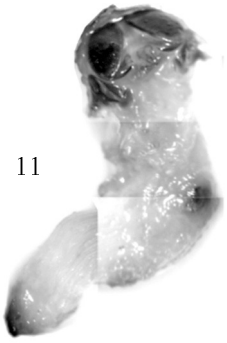
Figures 8, 9 & 10. Tegumen (8) with membranous penis (9) and chitinized part in front of the tegument (10) in a male of the species *C. aurata* (L.).

Comments on the established numerical ratio and sex index

It was established that the number of males exceeds the number of females in the majority of examined local populations of the species *C. aurata*, collected at 40 localities through 159 samplings. If we ignore cases with a small number of individuals (from one to four), we find a larger number of females only sporadically. The greatest disproportion between males and females was noticed in the sample from Jablanica where the sex ratio was 16.67 : 1.00 (July 21st, 2003, 50♂ : 3♀). Another sample with an extremely high number of males was collected in the vicinity of Rogatica (July 31st, 2003, 43♂ : 6♀). It had a numerical sex ratio of 7.17 : 1.00. High values of the sex ratio were also noticed at certain Montenegrin localities: Đurđevića Tara (sex ratio of 5.33 : 1.00, August 5th, 2002., 160♂ : 30♀) and Pljevlja (sex ratio of 4.54 : 1.00, August 5th, 2002, 59♂ : 13♀). This was observed as well at the Prijepolje locality in Serbia, e.g. at the sub–locality of Sopotnica (sex ratio of 4.13 : 1.00, July 31st, 2002, 33♂ : 8♀)

and the sub–locality of Mataruge (sex ratio of 4.84 : 1.00, July 29th, 2003, 92♂ : 19♀).

The other samples, especially those from Serbia and Montenegro, have about two times more males than females (Prijepolje: 4.84 : 1.00, Sopotnica: 2.32 : 1.00, Brodarevo: 2.06 : 1.00, Komaran: 1.83 : 1.00, and Serbia overall: 2.37 : 1.00; and Pljevlja: 4.54 : 1.00, Đurđevića Tara: 5.33 : 1.00, Mt. Durmitor: 2.53 : 1.00, and Montenegro overall: 4.43 : 1.00). In Bosnia, the trend was toward a greater number of males than females, but with somewhat lower values of the sex ratio.



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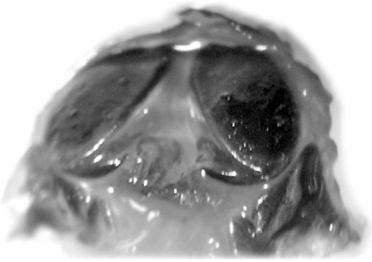

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Figures 11 & 12. Genital apparatus of a female of the species *C. aurata* (L.) (11) with enlarged copulative aperture (12).

In a significant number of samples, the numerical sex ratio was approximately equal to one, which is to say that there were only slightly more individuals of one sex (this applies to all samples with a single–digit number of individuals).

However, there were a few exceptions, in other words samples with a greater number of females. Such samples were those from Olovo (sex ratio of 0.44 : 1.00, July 13–15th, 2003, 14♂ : 23♀), Jablanica (sex ratio of 0.64 : 1.00, July 2003, 21♂ : 33♀) and Živogošće (sex ratio of 0.67 : 1.00, July 29th, 2003, 16♂ : 24♀).

It is interesting to note that in the samples in which only one individual of the examined species was collected, the female sex prevaied (60 samples: 37 with a female and 23 with a male).

In order to make the numerical sex ratio by localities easier to consult, the relative number of females was derived:

$$Rf = \frac{f}{(f + m)}$$

where *Rf* is the relative number of females in the sample, *f* is the absolute number of females in the sample and *m* is the absolute number of males in the sample (SERNA *et al.*, 2004. In older entomological literature, a similar calculus is known as the "sex index" (NONVEILLER, 1960).

In calculating the sex index with attention focused on the female sex, it was established that variability ranged from 0.00 to 1.00. However, all values of 1.00 (34 samples) involved extremely small samples (one or two individuals) with only two exceptions: May 31st, 1998, Sarajevo, 4♀ and June 13th, 1999, Sarajevo, 8♀. In a total of 136 samples, there were 18 with a greater number of females (12 with a single–digit number and six with a double–digit number of individuals per sample). In addition, it was established that 16 samples have an ideal numerical sex ratio (13 with a single–digit number and three with double–digit number of individuals per sample).

In the remaining 102 samples, males dominated. In 21 samples, only males were observed. Among them, six samples were with three to seven individuals (2x3, 1x4, 2x5, 1x7). Males were dominant in some 81 samples, which clearly proves overall male dominance in the samplings.

More precisely, only one total sample (Croatia) had a greater number of females than males (N 54: 24♂ : 30♀ or sex ratio of 0.80 : 1.00; Tab. II).

Comparison of the numerical sex ratio in the examined local populations established by the statistical model of chi–square test (χ^2)

In order to comprehend better the above–presented results, a comparison by the chi–square (χ^2) test was made. After reviewing the material, it was established that samples from some localities were too small for this type of analysis and a selection of more authentic samples was made (nine from Herzegovina and Herzegovina as a whole, six from Bosnia and Bosnia as a whole, three from Croatia and Croatia as a whole, four from Serbia and Serbia as a whole, three from Montenegro and Montenegro as a whole for a total of 2,182 individuals; Tab. II).

The analysis indicated that only one out of three samples from Croatia has statistical significance, and that the total number does not show the statistical significance of the numerical sex ratio ($0.50 > p > 0.30$). Only two out of nine samples from Herzegovina show statistical significance, but the total numerical sex ratio, unlike the previous case, is statistically significant ($p < 0.001$). Only one out of six samples from Bosnia is not statistically significant, and the total numerical sex ratio is also significant ($p < 0.001$). All samples from Serbia and Montenegro are significant ($p < 0.001$). The total number of males and females clearly demonstrates significantly more males than females, e.g. almost twice as many males in the sample (sex ratio of 1.88 : 1.00) which represents a statistically significant difference according to the method used (Tab. II).

Table II

Numerical ratio of males and females of the species *C. aurata* (L.) and values of χ^2 and the probability (p) of accidental occurence of differences at the examined localities (N – sample, M – males, F – females, χ^2 – chi–square, p – probability of differences determined by chance at the sampling sites).

Sampling sites	N	M	F	χ^2	p
Neum	29	20	9	4.18	0.05 > p > 0.01
Hutovo Blato	5	3	2	0.20	0.70 > p > 0.50
Kravice (Ljubuški)	25	14	11	0.36	0.70 > p > 0.50
Blagaj	41	24	17	1.20	0.30 > p > 0.10
Mostar + Drežnica	29	13	16	0.31	0.70 > p > 0.50
Jablanica	170	114	56	19.79	p < 0.001
Mt. Čvrsnica	38	19	19	0.00	p > 0.90
Mt. Prenj	9	6	3	1.00	0.50 > p > 0.30
Konjic	107	63	44	3.37	0.10 > p > 0.05
Herzegovina Sum.	453	276	177	21.64	p < 0.001
Mt. Vran	18	10	8	0.22	0.70 > p > 0.50
Mt. Vranica	15	12	3	5.40	0.05 > p > 0.01
Sarajevo	445	246	199	4.96	0.05 > p > 0.01
Mt. Romanija	212	141	71	23.11	p < 0.001
Rogatica	49	43	6	27.94	p < 0.001
Olovo	55	18	37	6.56	0.05 > p > 0.01
Bosnia Sum.	794	470	324	26.85	p < 0.001
Ston + Živogošće	4	1	3	1.00	0.50 > p > 0.30
Pelješac	8	7	1	4.50	0.05 > p > 0.01
Makarska	42	16	26	2.38	0.30 > p > 0.10
Croatia Sum.	54	24	30	0.67	0.50 > p > 0.30
Prijepolje	111	92	19	48.01	p < 0.001
Sopotnica	63	44	19	9.92	0.01 > p > 0.001
Brodarevo	324	218	106	38.72	p < 0.001
Komaran	68	44	24	5.88	0.05 > p > 0.01
Serbia Sum.	566	398	168	93.46	p < 0.001
Pljevlja	72	59	13	29.39	p < 0.001
Đurđevića Tara	190	160	30	88.95	p < 0.001
Mt. Durmitor	53	38	15	9.98	0.01 > p > 0.001
Montenegro Sum.	315	257	58	125.72	p < 0.001
SUMMARY	2,182	1,425	757	204.50	p < 0.001

CONCLUSIONS

Several fundamental conclusions can be drawn from analysis of individuals from a local population of the species *Cetonia aurata* (Linnaeus) from the vicinity of the village of Pediše on Romanija Mountain. The existence of sexual dimorphism was confirmed in the examined species.

It was ascertained that the tibiae of the first pair of legs in both males and females have thorn–like protuberances on the outer side, and they are more developed and more pointed in males.

The preapical spine of the first pair of legs is slenderer, more pointed and bent downwards in males, while in females it is usually shorter and thicker.

Females are clearly differentiated from males by the rounded abdomen, which in males is with a more or less marked impression.

It was proved that superficial appearance of the ventral side of the abdomen is the stablest distinguishing sexual characteristic of individuals of the examined species.

The material originates from 40 localities (in Croatia, Bosnia and Herzegovina, Serbia, and Montenegro) and was collected on 136 field trips yielding a total of 159 samples.

A comparative analysis of the sex ratio in individuals of the species *C. aurata* from local populations and metapopulations in Bosnia and Herzegovina and neighboring countries was conducted.

It was established that the number of males exceeds the number of females in the majority of samples.

The greatest disproportion between males and females was noticed in the samples:
– Jablanica, BiH, (sex ratio of 16.67 : 1.00, July 21st, 2003, 50♂ : 3♀),
– Rogatica, BiH, (sex ratio of 7.17 : 1.00, July 31st, 2003, 43♂ : 6♀),
– Đurđevića Tara, Montenegro, (sex ratio: 5.33 : 1.00, August 5th, 2002, 160♂ : 30♀),
– Pljevlja, Montenegro, (sex ratio of 4.54 : 1.00, August 5th, 2002, 59♂ : 13♀),
– Prijepolje, Serbia: Sopotnica (sex ratio of 4.13 : 1.00, July 31st, 2002, 33♂ : 8♀), Mataruge (sex ratio of 4.84 : 1.00, July 29th, 2003, 92♂ : 19♀).

The other samples, especially those from Serbia and Montenegro, had about double the number of males than females.

A disproportion between male and females, but with somewhat lower values of the numerical sex ratio, was noticed at other localities in Bosnia and Herzegovina.

A smaller number of samples (16) exhibited an approximately equal number of individuals of both sexes in the examined populations.

It was established that there are exceptions, e.g., samples with more females than males:
– Olovo (sex ratio of 0.44 : 1.00, July 13–15th, 2003, 14♂ : 23♀),
– Jablanica (sex ratio of 0.64 : 1.00, July 2003, 21♂ : 33♀),
– Živogošće (sex ratio of 0.67 : 1.00, July 29th, 2003, 16♂ : 24♀).

Calculation of the "sex index" or relative frequency of females showed that its values range from 0.00 to 1.00. The following values were observed:
– 34 samples had a value of 1.00,
– 18 samples were with the greater number of females,
– 16 samples were with an ideal numerical sex ratio,
– in 102 samples males dominated,
– in 21 samples only males were observed.

Of the total samples, only the total sample from Croatia had a greater number of males than females.

The analysis indicated that only one out of three samples from Croatia has statistical significance, and that the total number does not show statistical significance of the numerical sex ratio.

Only two out of nine samples from Herzegovina show statistical significance, but the total sample is statistically significant.

Only one out of six samples from Bosnia is not statistically significant, and the total sample is also statistically significant.

All samples from Serbia and Montenegro are significant.

The total number of males and females clearly demonstrates significantly more males than females, e.g., almost twice as many males in the sample (sex ratio of 1.88 : 1.00) which represents a statistically significant difference according to the method used.

Males often appear earlier in nature and stay longer in the air, while females appear somewhat later than and are forced to spend a period of time on the ground in order to lay their eggs, so that in samples collected in the early morning and late afternoon, in higher and colder regions, male individuals prevail.

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ПОЛНЕ КАРАКТЕРИСТИКЕ И „SEX RATIO“ У ОДАБРАНИМ ЛОКАЛНИМ ПОПУЛАЦИЈАМА ВРСТЕ *CETONIA AURATA* (LINNAEUS, 1761) (SCARABAEOIDEA, COLEOPTERA) У БОСНИ И ХЕРЦЕГОВИНИ И СУСЕДНИМ ЗЕМЉАМА

МИРЗЕТА КАШИЋ-ЛЕЛО И СУВАД ЛЕЛО

И З В О Д

У овом раду је извршена анализа основних полних карактеристика врсте *Cetonia aurata* (Linnaeus, 1761), на одабраном статистичком узорку од 30 мужјака и 30 женки из локалне популације са подручја села Педише на планини Романији. Након несумњиве потврде о постојању јасног полног диморфизма, тј. одређивања прецизних комбинација егзоморфолошких карактеристика за препознавање једног, односно другог пола, анализиран је материјал из 40 локалних популација, добијен током 159 теренских излазака (изведених у периоду од 1998. до 2004. године), са укупним бројем од 2229 јединки, сакупљених на подручјима: јужне Босне, Херцеговине, источне Далмације, јужне Србије и северне Црне Горе (Слика 1 и Табела I; KAŠIĆ–LELO, 2005).

У првом поређењу прерачунат је релативни број мужјака у односу на женке (sex ratio), при чему је констатовано да је, према очекивању, број мужјака, углавном, знатно већи у односу на број женки, у узорцима.

Иза прерачунавања бројног односа полова извршена је статистичка анализа путем хи-квадрат (χ^2) теста да би се установило да ли је уочени бројни однос статистички значајан. Међутим, прегледом материјала констатовано је да су узорци са појединих локалитета премали за статистичку анализу па је материјал прегрупиран у: девет узорака са подручја Босне, шест узорака са подручја Херцеговине, три узорка са подручја источне Далмације (Хрватска), четири узорка са подручја јужне Србије и три узорка из северне Црне Горе, а затим је прерачунат и укупан број мужјака и женки за свако поменуто подручје и целокупан узорак од 2182 јединке: 1425 ♂:757 ♀ (Табела II).

Поређењем је констатовано да је број мужјака у правилу већи у скоро свим анализираним узорцима, али и да је констатовани однос мањи у медитеранским и субмедитеранским подручјима.

Анализа је показала да од три узорка из Хрватске само један залази у подручје статистичке значајности, али да укупан број не показује статистички значај бројног односа полова ($0{,}50 > p > 0{,}30$). Од девет херцеговачких узорака само два

показују статистички значај, али, за разлику од претходног, укупни бројни однос полова је статистички значајан ($p < 0,001$). Од шест босанских узорака само један није статистички значајан, тако да је и укупни бројни однос полова био значајан ($p < 0,001$). Сви узорци из Србије и Црне Горе били су сигнификантни ($p < 0,001$). Током узорковања, и анализом података, уочено је да се мужјаци у природи у правилу појављују раније, као и да се задржавају дуже у зраку, док се женке појављују нешто касније у односу на мужјаке, а присиљене су један период проводити на и у земљи ради полагања јаја, тако да у узорцима који се сакупљају рано у јутро и касно пред вече, као и у височијим и хладнијим подручјима, преовладавају јединке мушког пола (Табела II).

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